

SPEED HUMP IMPACTS ON EMERGENCY RESPONSE TIMES
EUGENE FIRE AND EMERGENCY MEDICAL SERVICES

EXECUTIVE LEADERSHIP

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ABSTRACT

Ensuring effective and timely response of resources to emergencies is a basic responsibility of the fire service manager. This applied research project examined the issues around placement of speed humps on city streets and their impacts on emergency response.

The problem was that with the significant increase in requests for traffic calming devices, no comprehensive analysis of the impacts of speed humps on fire department response had been done. Without this hard data, it was difficult to establish guidelines and policy regarding placement of speed humps based on relevant local information.

The purpose of this research was to collect and evaluate information regarding traffic calming devices, specifically vertical speed "humps" that impact emergency response. That information was then used to create a guideline for fire service managers and city staff to help address requests for traffic calming devices. The research reviewed current city traffic calming issues and considerations, identified response time impacts utilizing time and distance trials, and explored the need for policy definition related to identified needs.

The research project employed action research to answer three research questions: What standards and guidelines exist in the city of Eugene for placement of speed humps? What impacts do speed humps have on emergency vehicle response? What would be appropriate internal guidelines for processing requests for traffic calming devices? Research procedures were focused on a literature review of current information, and a time trial which provided data to help answer the research questions. This information was then utilized to determine relevance and application to current Eugene practices.

The major findings of this research were: 1) Regulations regarding the design, construction and placement of traffic calming devices are established at the local level, and that there was considerable opportunity to influence this decision making process. 2) Time trials showed an average delay to emergency response vehicles of 3.6 seconds per speed hump over an established test course. Based on these findings, it was clear that speed humps do pose a negative impact on emergency response times. 3) A comprehensive guideline needed to be created for processing requests for traffic calming devices. 4) A partnership approach to processing traffic calming requests was found to be essential to resolving the problem.

Recommendations for Eugene Fire and EMS that resulted from this study included:

1) Review and implement the draft Memorandum of Understanding between Eugene Fire and EMS Department and Eugene Department of Public Works, Transportation Division. 2) Provide a detailed map showing all primary response routes for emergency Fire and EMS equipment which will not be subject to speed humps or other high impact traffic calming devices. 3) Prohibit installation of speed humps and other high impact traffic calming devices on primary response routes. 4) Develop a prioritization system for traffic calming solutions. 5) Implement an evaluation process to determine the effects of other types of traffic calming devices on emergency response times.

These needed changes would enhance the Fire and EMS Department's ability to influence the decision making process, and to maintain an appropriate level of safety and service for our personnel and the public.

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INTRODUCTION

Ensuring timely and appropriate response to emergency incidents is a critical duty for the fire service manager. Fire departments across the United States are challenged to consistently ensure adequate street access and travel routes and to minimize response times for fire and emergency medical response. Appropriate planning and analysis of traffic calming and street engineering issues can help overcome these challenges, and will provide added operational efficiency and an increased level of safety for emergency responders and the public.

Historically, the Eugene Fire and Emergency Medical Services (EMS) Department has been involved with street design and alterations as development and street changes have occurred. Over the past five years, a period of rapid and sweeping change, the department's ability to address the myriad of proposed changes in street design, construction, and alteration has been challenged. A groundswell of requests for traffic calming implementation has come from neighborhoods and residents of individual streets as traffic volume and speeds have significantly increased. The planning section of the fire department has dealt with an expanding number of requests for input from city traffic planners and engineers. This situation demonstrates a need to improve the department's ability to analyze and make recommendations for appropriate placement of traffic calming devices.

The problem was that with the significant increase in requests for traffic calming devices, no comprehensive analysis of the impacts of speed humps on fire department response had been done. Without this hard data, it was not possible to establish guidelines and policy based on relevant local information.

The purpose of this research was to collect and evaluate information regarding traffic calming devices, specifically vertical speed "humps" that impact emergency response. That information was then used to create a guideline for fire service managers and city staff to help address requests for traffic calming devices. The research reviewed current city traffic calming issues and considerations, identified response time impacts utilizing time and distance trials on existing streets with speed humps, and explored the need for policy definition related to identified needs.

Without a thorough review of procedures, the fire department would continue to be faced with a "case-by-case" review process and a continued lack of useful local data and guidelines to assist with the processing and placement of traffic calming devices.

The study used the action research methodology to apply research findings to current Eugene Fire and EMS traffic calming proposal evaluation procedures. This was accomplished by addressing the following research questions:

1. What standards and guidelines exist in the city of Eugene for placement of speed humps?
2. What impacts do speed humps have on emergency vehicle response?
3. What would be appropriate internal guidelines for processing requests for traffic calming devices?

BACKGROUND AND SIGNIFICANCE

The Eugene, Oregon Fire and EMS Department is a career organization with 205 employees, with approximately 156 of those employees on shift duty in three platoons. Eugene

is a city with a population of 139,500. The department's nine engine companies, two truck companies, and four ambulance companies are operated out of 10 stations, including an airport station with two aircraft rescue and fire fighting (ARFF) units. The department responded to approximately 18,000 calls for service in 1999 and maintains a high rating (class 2) with the Insurance Services Office, which rates fire departments for insurance purposes. Approximately 13,000 of the 1999 calls for service were for emergency medical related incidents.

Public reaction and response to high neighborhood traffic volumes and speeds has significantly increased in recent years. The benefits of traffic calming have been widely acclaimed by residents as they struggle to keep their environment safe from the onslaught of traffic. This traffic spills from primary travel streets, called arterials and collectors onto previously serene residential streets. Emergency services are often considered to be an obstacle to the resident's desires for a safe and secure neighborhood. The view that traffic calming measures should be a public recourse is often in direct conflict with the fire service's mission to minimize response time in order to save lives and property.

As late as 1995, there were very few traffic calming devices in place in the city of Eugene. The fire department had responded to the expanding traffic problem by installing traffic signal preemption devices (traffic light controls activated by emergency vehicles) on all major intersections in the city, but the question of emergency response and the impacts of traffic calming devices had not been a major consideration. A few traffic barriers and devices had been placed to address traffic problems on specific streets, but impacts to emergency response were minimal. Since that time (1995), the city has placed numerous speed humps on six (6) residential streets and has received requests for nearly 250 traffic calming projects involving more than 150 streets.

The situation presented opportunities to quantify response impacts due to speed humps and to create a template for fire service managers to work with Public Works staff and citizens to discuss and make recommendations regarding placement of traffic calming devices. This applied research is also related to the Executive Fire Officer course “Executive Leadership”. It presented an opportunity as a fire service leader to research and address an important community and operational concern. Based on this effort, the author was able to provide for the organization significant data to quantify the problem, and a draft guideline which addressed policy concerns.

LITERATURE REVIEW

In order to determine the significant issues related to traffic calming devices, specifically vertical speed humps, and to determine future directions and policy, it was important to examine literature from subject matter experts as published in related textbooks, correspondence, city policy, and industry periodicals. A review of available information on speed humps and traffic calming devices, the status of city policy and procedure related to those traffic calming devices, and fire department policy and practice was in order.

It was also important to establish a definition for traffic calming and speed humps as referenced in this research. The city of Eugene Local Street Plan (City of Eugene) defines traffic calming as “...various techniques to slow traffic and/or shift traffic to more appropriate routes”(p. 55). Additionally, speed humps are defined as:

Speed Humps: speed humps (also called undulations) reduce speeds on residential streets by compelling motorists to slow to residential speed limits when approaching the hump.

Speed humps are 14' to 22' in length and are approximately 3" high. They are most effectively used in clusters of three to five, and are generally installed at intervals ranging

from 200' to 500' apart. Speed humps are not to be confused with speed bumps. Speed bumps are much more abrupt, usually less than 3' in length, and are used in parking lots and private drives. Speed bumps are not used on public streets. (p. 57)

The Institute of Traffic Engineers (ITE) (1997) is specific regarding the purpose of the devices: "...speed humps are defined as a roadway geometric design feature whose primary purpose is to reduce the speed of vehicles traveling along that roadway" (p. 1). Savage and MacDonald (1996) observed that "In speed control, there is one primary rule: If you force the driver to make a significant side-to-side or up-and-down movement (lateral or vertical shift), almost every one slows down" (p. 28). Bunte (2000) notes that "These 'hard' control devices are largely self-enforcing and create a visual impression, real or imagined, that a street isn't intended for through traffic" (p. 15).

The use of speed humps, and traffic calming devices in general are a direct result of the increase in the population of our cities and the corresponding use of the automobile as a means of travel. There has been a notable reaction from affected neighborhoods. Residents began mobilizing, and city officials have been inundated with requests for traffic calming measures. As Engwicht (1999) observed:

Our streets have become like every other clogged artery anywhere else in the world. Residents move out and the international burger franchise stores move in. Our neighborhood begins to lose its distinctive feel and becomes part of a global culture. (p. 17).

Congestion on major arteries tempts drivers to use residential streets as a shortcut to their destination. Drivers often prefer winding their way through neighborhoods over sitting in stop-and-go traffic. Gradually, quiet neighborhoods streets become more heavily traveled and vehicle speeds increase. Eventually, the residents object to the danger, the noise, and the pollution.

Kroeger (1996) looks at resident reaction and community action and comments that, “In a desperate situation, desperate measures are taken”(p. 22). Further, he believes that, “Traffic calming is a tool of defensible space. Increasingly citizens are wanting to defend themselves against crime and the automobile” (p. 22). A significant factor in the discussion has become the increasing militancy and determination on the part of affected neighborhoods to resolve the problem by placing traffic calming devices on city streets.

Individual and public concerns often convey the desire to physically reclaim their streets and their neighborhood, and many take a global view of these endeavors. As Engwicht (1999) observes, “Street reclaiming is a technological leap beyond traffic calming. Not only does it reduce traffic volume and speed in your streets, it helps reclaim your street as a place for play, social activity, and community building” (p.19).

The objectives of traffic calming projects and speed hump installation were found to be fairly universal. The central issue is how, when, and if the calming measures should be applied. Bunte (2000) observes that the usual objectives that have been established for traffic calming programs were to “...slow traffic speeds; reduce cut-through traffic; increase the safety of pedestrians, bicyclists, and vehicles; reduce traffic noise; and improve the aesthetics of the neighborhoods” (p. 14). These objectives are similar to documented objectives for the City of Eugene traffic calming program.

The concepts of street reclaiming and the application of traffic calming devices are often in conflict with the mission of the fire department and other public sector service functions. The Fire and EMS services in Eugene adopted a four minute time frame as the goal for all fire and medical response. But, as Bunte (2000) observes in his research, "...providing this public good conflicts with the very core objectives of traffic calming programs" (p. 5). Bunte (2000) also captures the essence of the debate: "Traffic calming and emergency response: A competition of two public goods" (p. 5).

The placement of traffic calming devices will only increase in cities and communities across the country. Traffic humps have become one of the primary methods to address the problem. As Tabert (1997) observes, "Traffic calming devices are not just a passing fad. They are more cost efficient than traffic enforcement by law enforcement personnel and they are there 24 hours a day, 7 days a week" (p. 18).

The magazine *Status Report* (1998) reports the benefits of calming measures in Vancouver, Canada: "An average 40% reduction in crash frequency and 38% reduction in the annual cost of insurance claims", and "The studies show reductions in traffic volume and speeds" (p. 30). Other researchers have announced expectations of as much as 30% to 50% less traffic on the roads at peak hours, top speeds down by 50%, 40-60% less chance of being killed or seriously injured in an accident, and noise and pollution reduced by up to 50%. These astounding projections would cause anyone to advocate for traffic calming measures.

With this overview in mind, the literature research focused on addressing the research questions. In order to simplify and organize pertinent literature review, the information is divided into three main topic areas that follow the research questions previously established.

What standards and guidelines exist in the city of Eugene for placement of speed humps?

In order to understand and address this question, it was important to review current city policy and direction regarding the implementation of speed humps and traffic calming projects. An important point to consider is that in the United States, cities and local jurisdictions have the authority to address traffic calming issues. No national standards for traffic calming programs were found in the literature research. The U.S. Department of Transportation (DOT) leaves control and administration of these programs to local government. Calongne (1999) observes that the DOT established warrants for the design and use of recognized traffic control devices, but “There are no established warrants for traffic calming devices” (p. 1).

The Eugene Local Street Plan (1995) references the fact that In 1991, The Oregon Land Conservation and Development Commission (LCDC) adopted the Transportation Planning Rule. This state rule “requires cities of more than 25,000 population to adopt bike, transit, and pedestrian-friendly development standards” (p. 2). The city of Eugene created new standards to comply with the rule.

The Institute of Transportation Engineers (ITE) was found to be a recognized source for recommendations regarding residential street design and traffic control. This society of transportation professionals is dedicated to the safe, efficient, and environmentally sound movement of people and goods. The ITE provides resources to help transportation professionals meet those needs. The ITE book, *Residential Street Design and Traffic Control* by Homburger, Deakin, Bosselmann, Smith, and Beukers (1989) is used extensively by city planners and engineers as traffic calming projects are reviewed and implemented.

In the absence of any clear higher government statutory authority, the city of Eugene has combined the precepts and recommendations of the ITE with a localized and common sense approach to implementation of traffic calming techniques. City of Eugene (1999) states that, “The application of these techniques is based on a case-by-case basis using engineering judgement” (p. 39). The city normally adheres to the ITE recommendations, but includes a project-specific review process which may vary occasionally from the ITE standards. In the ITE street design handbook, Homburger et al. (1989) notes that “...it is essential that designers develop compromises and consider tradeoffs” (p. 21). The city has adhered to this philosophy and combined the ITE standards with local needs and situations in a holistic approach.

The placement of traffic calming devices (and speed humps) is a notable item of concern to the ITE. Homburger et al. (1989) are clear that “Undulations [traffic humps] should *not* be placed on primary emergency vehicle access/egress routes nor on important transit routes” (p. 106), and additionally, “...alternate routes should have been worked out so that disruption to their functions is minimized” (p. 124). These concepts of emergency response priority were found to be advocated throughout the literature review.

Two important city documents furnish guidelines for city planners and engineers regarding consideration and implementation of traffic calming devices. The Eugene Local Street Plan (1995) and the Eugene Arterial and Collector Street Plan (ACSP) (1999) provide guidance for planners and engineers. The local street plan provides planning principles for layout and design of city streets as well as recommendations for new standards and maps.

The ASCP clarifies and implements existing city policy related to the design of major (arterial and collector) streets. The plan establishes street classifications and clarifies the process for making decisions that affect existing streets. The plan also clarifies how traffic calming

techniques would be used on these streets. The ACSP states that “Major streets serve as primary emergency vehicle response routes”(p. 25). Additionally, the plan states that “Traffic calming devices used on major streets should not significantly reduce [*sic*] emergency response times” (p. 73). The plan advised that traffic calming devices are “intended for use on local streets, but may be used on collector streets”. These rules were found to be an excellent basis for any discussion regarding response routes and proposed traffic calming changes to those routes.

The City of Eugene Neighborhood Transportation Program was initiated in 1995. Transportation staff have worked diligently to address the continuing increase in requests for traffic calming measures on city streets. The city transportation staff completed the most recent traffic calming project from the Traffic Calming Fund in 1998, and no new projects from that fund have been initiated. This delay was due to the revision of the ACSP. Duke (2000) reports in his “Traffic Calming Status Report” that the ACSP has been adopted and the plan “clearly identifies the types of traffic calming to be allowed on the various street types”(p. 1). Additionally, Duke (2000) reports that city staff were in the process of “developing a pilot program to test the potential for privately financed traffic calming measures” (p. 2). The city was now poised to begin the implementation of additional traffic calming devices as internal and external revenues became available.

Duke (2000) also addresses the fact that a number of changes from the previous city traffic calming standard have been adopted, including the eligibility requirements regarding street speed and flow:

Minimum daily average traffic volume (MDA) of over 600-800 daily volume or that the street must have a measurable speed study result indicating a minimum of 50% of the measured traffic traveling over the posted speed, AND that the street must have a minimum 85th percentile speed of five miles an hour over the posted speed” (p. 2).

In addition to these requirements, a petition signed by two-thirds of the affected property owners is necessary for eligibility for consideration for traffic calming device placement. There are currently five street calming projects proposed for fiscal year 2000-01.

Clearly, the city has worked to define project policy and process, and will continue to do so. The city’s work has focused on guidelines, and the research found considerable flexibility in defining process and implementation requirements. The newest city standard, the ACSP, recommends that “Planning and design should be coordinated with nearby residents as well as emergency and other service providers who will be affected by their use” (p. 39)”. The plan makes no further definition regarding this important piece of the decision making process for placement of traffic calming devices.

The research regarding existing standards shows that there are opportunities for the fire department to impact existing and future traffic calming projects based on current policy and practice. It also demonstrates that quantified data derived from existing city speed hump projects could be utilized to help determine guidelines for future projects.

What impacts do speed humps have on emergency vehicle response?

A review of the literature associated with traffic calming devices and their effects on response times yielded significant variations in opinion regarding this question. On one hand, credible professional manuals including the Homburger et al. (1989) publication, *Residential Street Design and Traffic Control* make little reference to quantified impacts of speed control

devices other than advising that the devices should not be used on major response routes, and that the planning process should take into account emergency response concerns. The manual only references the fact that speed control device impacts include “...increased emergency response time” (p. 129).

At the other end of the spectrum are those who believe the devices should never be used. The City of Rancho Cucamonga (2000) concludes that “the control of speeding in residential neighborhoods is a widespread concern which requires persistent law enforcement effort, not speed bumps...they [speed humps] are therefore, not used” (p. 1). Extensive quantitative data regarding specific impacts on emergency response was not found. However, some studies give an indication of specific problems regarding speed humps and emergency response.

A number of impacts were found that were not directly related to response time. The research identified other important aspects of fire department operations that could be affected, including wear-and-tear on apparatus, detrimental effects to patients during emergency medical services (EMS) transport, and injuries to firefighters as fire apparatus is driven over vertical humps.

Numerous single references to firefighter injuries due to hitting the ceiling of apparatus during response were listed, but the problem was not quantified with reliable data. Bunte (2000) found that due to the shifting of the patient compartment, injuries to patients during medical transport did occur. Bunte concludes that, “Obviously, this type of transport condition can have very detrimental effects upon cardiac patients or severe trauma patients” (p. 44). Homburger, et al. (1989), makes it clear that, “Avoiding primary ambulance routes is a key consideration in the use of undulations and other pavement roughness treatments, because ambulance patients may be extremely sensitive to vibrations during the trip” (p. 117).

Bunte (2000) refers to the city of Austin analysis, which determined that “Austin would lose an additional 37 lives per year with patients of sudden cardiac arrest if the Fire and EMS Departments experienced a 30 second delay in response times due to traffic calming” (p. xi). From this discussion, Bunte concludes that, “A *risk/benefit* analysis also demonstrated that traffic-calming devices have more of a negative impact than a positive impact to the community” (p. xi). This analysis was found to be very pointed in its condemnation of the speed humps, but comprehensive background information which could lead to the conclusions was not found.

References to damage to fire apparatus due to crossing speed humps were also found in the research, but no data was available to substantiate the problem. Caldwell (1999) observes that “...traveling over one of these devices at any speed above a crawl can cause serious damage to apparatus components” (p. 40). A major premise is that repeated shocks as well as sudden, heavy impacts affect the suspension, frame, drive train, and sensitive apparatus components. The concern regarding wear-and-tear related to fire and EMS vehicles crossing vertical obstacles would be extremely difficult to prove. However, some fire department maintenance shops are convinced that the damage was directly related to speed humps. The overall conclusion is that traveling over speed humps resulted in shortened apparatus life and increased repairs.

Another area of concern which did provide quantitative research data was the effect of speed humps on response times for emergency vehicles. Tests have been conducted in a number of cities in this country which provided data. Bunte (2000) found that, “Combined findings of the Portland, Austin, Montgomery County, and Berkeley tests confirm that speed humps cause considerable delays for emergency response vehicles” (p. 59). Bunte concludes “Thus, all of these tests substantiate that traffic-calming devices pose a negative impact to the outcome of life-threatening incidents and other emergency service level deliveries” (p. 59).

Bunte (2000) references a number of studies that establish values for response delays due to speed humps. The Portland OR (1996) study found a range of delays for all types of vehicles for the 14 foot speed hump of 1.0 to 9.4 seconds per hump. The Austin TX (1996) study found that the time increase to traverse speed humps was approximately 2 to 10 seconds. The Montgomery County (1997) test found a delay range of 2.8 to 7.3 seconds. The Berkeley CA test (1997) results suggests an increase of 10 seconds per hump for fire apparatus tested (EMS equipment was not included). McGinnis (1997) adds that the Berkeley test also found that generally "...20 miles per hour was close to, or more than, the reasonable safe speed to cross a speed hump" (p. 81).

At the higher end of the scale, Tabert (1997) concludes in a Longmont CO study that, "The results show that for the most part 15 seconds per device is a good estimate of additional time caused by traffic calming devices..." (p. ii). This value is well above the values found in the four studies cited earlier, and was not included in the averages utilized in this research.

Based on his review of the data from the four studies, Bunte (2000) concludes, "Thus all of these tests substantiate that traffic-calming devices pose a negative impact to the outcome of life threatening incidents and other emergency service level deliveries" (p. 59). Gutschick (1998) echoes this conclusion: "Despite their benefits, speed humps and traffic circles, in particular, have several disadvantages, not the least of which is the significant delay they create for responding fire-rescue apparatus" (p. 122).

It is interesting to note that no documentation was found which addresses speed hump impacts on grades. Homburger et al. (1989) recommend that, “Undulations [traffic humps] should *not* be used on grades greater than 5 percent.” Other references, as well as the City of Eugene practice were shown to have higher limits to these guidelines. The City of Eugene (1999) references no specific grade limitations, but planners and engineers consider grade issues separately with each individual project. Slope constraints were found to be one of the criteria for exceptions to placement of traffic calming devices. An additional complication was noted regarding slope: snow and ice collecting above speed humps installed on grades could become a hazard which would significantly impact emergency response times. Again, no data to quantify this problem was found in the research.

The literature search regarding impacts of speed humps clearly indicates that more quantitative data is needed to address how these devices affect Fire and EMS response. The research indicates a need for time trials to quantify the problem. The resulting data could be used by fire department officials and public works staff to inform the public and to create appropriate process and working agreements to address the problem.

What would be appropriate internal guidelines for processing requests for traffic calming devices?

From these indications, a problem does exist with emergency response delays due to the use of speed humps. It is also apparent that a literature review of existing procedures for considering requests for traffic calming devices is warranted. The research calls for an inquiry into current status of fire department involvement in the decision making process and a review of appropriate guidelines to enable managers to effectively process speed hump placement requests.

Due to the current number of traffic calming devices in place on America's streets, and the explosion of requests for continued placement of the devices in Eugene, it is clear that fire departments and public officials must work together to address these requests. As Caldwell (1999) observes, "In the final analysis, planning, communication and cooperation are essential" (p. 41). Without adequate policy and a good working relationship with city planners and engineers, the challenge to fairly and appropriately address traffic calming issues without undue conflict would intensify.

Partnerships were found to be a key to appropriately addressing requests for traffic calming. A consistent and fair process would result in predictable outcomes and cooperative effort. As Nuttall (1999) observes, "The study results suggest that a cooperative partnership can be forged between those concerned with emergency response and others concerned about neighborhood livability. The two issues do not need to be mutually exclusive" (p. 18). This cooperative approach and the need for flexibility are further defined by the County Surveyors Society (1994):

If there is one piece of advice I would give, it is to stress the importance of establishing a dialogue with local people and the other bodies involved, at the earliest possible time; and to continue this through design, implementation, and monitoring. Proper dialogue means being prepared to listen, to change both your mind and the scheme (p. 1).

A central question appears to be the extent to which the fire department should be able to dictate parameters for installation of traffic calming devices. Bunte (2000) recommends that, "Emergency service departments should have the authority to disallow traffic calming plans that will adversely impact their response service delivery" (p. 194). This precept is not included in the City of Eugene planning and policy documents.

The city has utilized a flexible approach to processing traffic calming issues. For example, City of Eugene (1999) states that, “A one standard fits all approach to street design is inconsistent with attempts to maintain livability under these conditions” (p. 10). This philosophy appears to apply to the city project review and approval policy as well. The process for traffic calming is only generally outlined: “City staff must work with local residents to apply the most appropriate type of traffic calming to each street”. (p. 38)

Along with these policy considerations, it is apparent that future changes and developments in technology and design required cooperative analysis. City of Portland (1998) has addressed this issue:

The Traffic Calming Program, the Fire Bureau, and the Police Bureau will continue to cooperatively address problems of excessive speeds and volumes on residential streets. This will include, but not be limited to, the evaluation of all new traffic slowing devices to determine their impact on emergency response providers and the development of cooperative educational programs. (p. 6)

This recommendation for a cooperative evaluation process provides the foundation for interaction and creation of policy between city departments. The literature search indicates that work needs to be done to improve communication and cooperation as city staff process the significant increase in applications for speed humps and other traffic calming devices on city streets.

A number of themes were found in the literature regarding recommended fire department policy for placement of speed humps in the community. It was found that the devices were not advised on streets where fire stations were located, or on primary response routes. Additionally, the devices were not recommended on streets which connect neighborhoods. Response routes

were found to be an important consideration: identified and documented routes were considered an essential component to providing appropriate policy. Another recommendation was to develop guidelines (often presented in a memorandum of understanding or a city council policy document) which outline the responsibilities and basic needs of public agencies or departments

PROCEDURES

A literature review was first conducted in order to obtain an academic understanding of the underlying principles and practices regarding speed hump impacts and fire department policy issues related to speed humps and traffic calming devices. This research was done primarily through the National Fire Academy's Learning Resource Center in Emmitsburg, MD. In an effort to answer the three research questions, textbooks, trade journal articles, government handbooks, and technical papers were reviewed. Common issues were analyzed, and common themes were identified. City of Eugene policy and practices were reviewed utilizing applicable city documents. This information was then compared to accepted national practices and themes as outlined in the literature review for consistencies and appropriate areas for improvement.

Speed hump time trials were developed based on the research questions and identified areas for clarification based on the literature research. The time trials were conducted by the author with assistance from fire department and public works personnel on October 26, 2000. The time trials were designed to quantify the delay to fire and emergency medical vehicles caused by speed humps on a selected flat road surface.

The speed humps utilized for the testing were located on Friendly Street in the City of Eugene. The speed humps were 14 feet wide, measured from curb-to-curb. The speed humps at the site were found to be slightly higher and longer than those at some of the other installations around the city, but were found to be standard for installations on flat ground. The speed humps on Friendly Street were approximately four inches high at the center of the hump.

Three vehicles were utilized for the testing. Those emergency vehicles included a pumper (also referred to as an engine), an aerial platform (ladder truck with aerial device), and an ambulance (medic unit). These vehicles were representative of the three primary types of emergency response apparatus utilized by the Eugene Fire and EMS Department. The vehicles were driven by qualified apparatus operators familiar with the operation of each type of equipment.

The testing considered four variables which influenced the speed at which an emergency vehicle could be driven across speed humps, including the vehicle type, the driver, the ability to maintain the desired vehicle speed, and the variation in width and height of the speed humps used in the testing. For various combinations of the four variables, the time needed to travel a length of street that had no calming devices was compared to travel the same length of street with speed humps in place.

Prior to conducting the tests, dimensions and weights of test vehicles were established and recorded. Street lengths and speed hump dimensions were established. Additionally, participants and operators were provided an orientation to the test sites and a briefing regarding the purpose and procedures for the tests. Emergency vehicle operators were asked to simulate driving under emergency response conditions with warning devices (emergency lights activated),

and to maintain predetermined speeds after slowing for each speed bump. Sirens were not used during the time trials.

The absence of fixed traffic control devices (stop signs, traffic lights) on the driving course ensured consistent vehicle speed values from start to finish. The tests were conducted in dry weather during the afternoon of October 26, 2000.

Test procedures on both courses required each apparatus to accelerate to the desired steady speed of 25 mph as quickly as possible, to maintain that speed as much as possible through the course, and to slow to a reasonable speed (from the driver's perspective) to cross the speed humps. The same test for each apparatus type was then conducted using 30 mph as the desired speed. The 25 and 30 mph speed values were chosen based on the posted speed limits and typical emergency response speeds in neighborhoods.

A control course was established for the test which provided the same distance and conditions as the speed hump course, but without speed control devices present. The next street to the west, Adams Street, was the control street. Identical conditions existed on Adams Street, including grade, street width, and side street traffic controls, but no speed humps were present.

The total time for the test course with speed humps was recorded for each combination of apparatus type, driver, and desired speed, and compared to the corresponding time recorded for the control route. The average difference in the two times for each vehicle type was determined, and that value was divided by the number of speed humps on each of the two courses. The resulting value represents the average delay time for each speed hump on the course for each vehicle type. A comprehensive value for the average delay time per speed hump for the course was derived by averaging the delay times for all three vehicle types.

Limitations of this survey include the number of tests conducted and operator accuracy. Another limitation of the research is that a comprehensive testing of various speed hump applications at other sites was not done due to the current limited number of streets with speed humps installed. An additional limitation is that there are other Eugene fire and emergency medical vehicles which might produce different travel times if they were utilized in the same test due to mechanical condition, and engine and braking capability. Heavier vehicles took more time to initially reach designated speed (25 and 30 mph).

An additional limitation is that the length of the streets tested was relatively short in comparison to the average distance normally traveled by responding fire apparatus. Other types of traffic calming devices were not tested as a part of this research. This fact limits the scope of the analysis specifically to speed humps.

Since the test was designed and conducted so as to reasonably simulate emergency response, the results should accurately predict response time delays due to speed humps for the specific location and conditions tested. The results may further indicate some general response impacts from speed humps. Additionally, the results could be useful in Eugene Fire and EMS guidelines to address requests for speed humps in the city.

It should be noted that the research does not lead to direct conclusions regarding when, where, or how to utilize speed humps. The results of the research provide one of the many pieces of information that could help decide where placement of speed humps could be supported or rejected by fire department managers.

RESULTS

Results from the literature review and time trial tests provide specific answers to the three research questions using the action research methodology. The research produced specific data related to impacts of speed humps on emergency vehicles, specific recommendations, and a proposed memorandum of understanding which addresses guidelines for processing requests for speed humps and traffic calming devices.

1. What standards and guidelines exist in the city of Eugene for placement of speed humps?

The literature indicates that the City of Eugene has followed the recommendations of the ITE, and has adjusted those standards based on specific needs according to the street, the neighborhood, and to the individual engineering requirements of each project. It is clear that the city has created a system for processing requests, applying policy, and implementing traffic control projects. Overall, it is apparent from the literature review that the planning and placement of traffic control devices is derived from local authority, and that there is no higher authority which oversees this activity.

One area of concern that was identified from the research was the lack of specific definition regarding emergency response routes. While the literature was clear that primary emergency response routes should never have traffic calming devices in place, specific documentation is not currently in place in Eugene. While there have been verbal agreements regarding use of the city's new arterial and collector street designations, there is no formal policy requiring adherence to that designation. Additionally, there are connector streets for individual fire stations which are not currently designated collectors or arterial streets. These access streets are critical to enable emergency crews to get to the collectors and arterials which then allow

them access to emergency scenes in their response areas.

The review of current city policy and procedure showed a need for clarification regarding a number of areas of importance to fire department emergency response. Improved guidelines for street response designation are needed. An additional discovery was that there are currently no binding requirements for addressing department response delay concerns and issues. An opportunity exists to implement a binding interdepartmental agreement which will require department concerns to be formally considered and acted upon.

2. What impacts do speed humps have on emergency vehicle response?

The study shows that speed humps do impact emergency vehicle response not only in other cities where evaluations were done, but in the City of Eugene as well. The literature review showed that other associated problems were observed including damage to equipment, impacts to patient health, firefighter injuries, and delays due to installation of speed humps on grades. No evaluative work was found that measured these problems or confirmed any direct correlation to traversing speed humps. Thus, no conclusions could be reached regarding the effects on patients, apparatus, and firefighters.

The results of the time trials applied to conditions on one street with speed humps installed. Table 1 summarizes the time trial results. Complete time trial data can be found in Appendix A.

Table 1: SPEED HUMP TIME TRIAL SUMMARY	
Eugene Fire & EMS Apparatus:	Total Average Delay Per Speed Hump:
Engine 23	3.9 Seconds
Truck 22	4.9 Seconds
Medic 2	2.1 Seconds
All Apparatus	3.6 Seconds

The results from the time trials indicate that at the two desired speeds, it took an average of 3.6 seconds longer for the three types of apparatus to cross a single speed hump than it would have taken if the apparatus had been able to respond without slowing for the traffic calming device. It is evident from the time trials that the heavier and larger apparatus took longer to negotiate the course and, as a result, experienced longer delays. Analysis also showed that travel time delays increased as desired speed increased from 25 to 30 mph. The results showed that delays due to speed humps were consistently one to three seconds higher at 30 mph than they were at 25 mph for the same vehicle types.

Utilizing previously established values from the four studies mentioned (Berkeley, CA, Portland, OR, Austin, TX, and Montgomery County, MD), it is possible to establish the average range of times as well as an overall average value for the four studies. While there were a number of variables in the testing, it is reasonable to conclude that the cumulative average range for speed hump delays based on the four study results from the literature research was 1.3 to 8.9 seconds, with an overall average delay of 6.5 seconds for each speed hump encountered.

The Eugene average delay of 3.6 seconds per speed hump for all apparatus is considerably lower than the average value (6.5 seconds) found in the four studies referenced above. This difference may be attributed to any or all of the variables noted earlier. Including the Eugene data with the previous four studies provides the same value for response time range as previously determined, with an overall average response time delay of 5.9 seconds per speed hump for all apparatus.

The results of the Eugene time trials support the hypothesis that speed humps do cause delays to emergency response. The results also suggest that delays can be considerable depending on the number and location of speed humps placed in the City.

3. What would be appropriate internal guidelines for processing requests for traffic calming devices?

Clear direction was found in the research regarding recommended implementation of fire department and city policy for placement of speed humps in the community. Appropriate internal guidelines for processing requests for traffic calming devices are needed. The research showed that the current city policy leaves these issues “to be discussed,” rather than providing a solid position which would often answer any questions which may arise. The obvious solution, and one which is well documented in the literature, is to establish an agreement which provides in advance as much direction as possible when considering requests for such projects.

Partnerships were shown to be the key to success. A partnership with those agencies having primary responsibility for the decisions affecting emergency response is critical to successful outcomes. A partnership has been developed with City Public Works staff, but agreements should be formalized in order to present a unified approach to the consideration of project applications. Flexibility was also found to be an important ingredient to the process, and

a “one-size-fits-all” approach does not work. Instead, a solid set of written guidelines with the ability to negotiate exceptions should be an integral part of the process.

DISCUSSION

It is interesting to compare the findings of the literature research with the findings of the practical testing. To a great extent, the two have parallel results. While both have limitations as previously mentioned, similarities and differences can be discussed.

Both the time trials and the resource materials clearly support the concept that speed humps do have a negative impact on emergency response. The results of the Eugene time trials showed slightly lower values for response delays as compared to the four primary studies cited in the literature research, but the data is still very much in line with those studies. The variation in speed hump design and installation did undoubtedly have some effect on the outcomes. The individual driver’s skill and understanding of the test may have influenced the results, and the type and condition of the apparatus provided additional variables.

One interesting result noted was that the data showed no decrease in overall response time when the driver attempted to maintain 30 mph over the 25 mph desirable speed. As a matter of fact, overall travel time values were actually lower when attempting to maintain 30 mph speed with speed humps present. This may be a result of the increased braking anticipation and effort that takes place at the higher speed; and due to the short distance of the course, the inability to recover that lost time by maintaining the higher speed. Whatever the reason, the results would indicate that the lower of the two speeds (25 mph) would allow the apparatus to negotiate a street with speed humps quicker than the time required attempting to travel at the higher speed (30 mph).

It was clear that many of the negative impacts discussed in the literature were not substantiated by quantitative data, and the concerns regarding damage to apparatus, firefighters and patients were not a part of any conclusions from the research. While it is apparent that long term exposure of apparatus to speed bumps may result in damage to vehicles and increased negative effects on patients and firefighters, without valid data it is not reasonable to include these factors in any verifiable conclusions for this report. However, based on the results of the testing and literature research, it is reasonable to believe that increased use of speed humps may have a long term negative effect on these areas of concern.

Although a single speed hump represents a response delay which can be measured in seconds, multiple devices can extend this delay considerably. This fact should be considered when longer streets and multiple speed humps are proposed. The more devices present on a given route, the longer the delay. As speed bumps and other traffic calming devices proliferate, so does the potential for serious consequences from these delays. Cumulative delay, as well as numerous precepts established in the literature review (no placement of traffic calming devices on primary response routes, connecting streets to other neighborhoods, and streets in front of fire stations) should be serious project review considerations.

The research shows that the City of Eugene has done quite well as city staff have dealt with the challenges that traffic calming devices and speed humps present. That success was found to be a result of the establishment of sound standards and practice as evidenced by the implementation of earlier projects. The Eugene ASCP (1999) and the Eugene Local Street Plan (1995) are also evidence of these efforts. It was also shown, however, that work still needs to be done to further define specific interdepartmental practice and procedure as requests for traffic calming devices are processed.

The literature research and time trial results show that the considerations regarding the negative impacts of speed humps should be included in municipal policy and procedure. The values and information documented in this study can be utilized to help address the current backlog of project requests. Additionally, the time delay data can be used to assist with policy formation and individual project considerations. If additional speed humps are proposed, a cumulative time value can be derived which would indicate total response time delays for units responding from multiple directions. Additionally these established values can be utilized to inform the public about potential impacts to their personal safety and security.

There are additional implications for the organization as the new guidelines are established. As we discussed earlier, the fire department has entered into a cooperative partnership with other city departments to address traffic calming proposals as a whole. However, this effort needs to be formalized with written procedures which better define project limits based on fire department concerns. This will entail minimal work, and the product (Appendix C) should be adopted and regularly reviewed. The agreement should result in a streamlined effort which provides clear direction on many issues rather than a constant negotiation process. The results of this research and the improvement of processing guidelines will assist city staff and provide an increased level of community understanding and appreciation of fire department concerns.

RECOMMENDATIONS

A number of changes to current practice are recommended as part of this research. Utilizing this research document and the attached Memorandum of Understanding (Appendix C), changes should be implemented as listed in these recommendations to bring procedures in line with recognized practice. Implementation of the following recommendations is advised:

1. Review and implement the draft Memorandum of Understanding between Eugene Fire and EMS Department and Eugene Department of Public Works, Transportation Division.

This draft MOU (Appendix C) has been developed based on the issues and solutions identified in this study. Process improvements have been included in the document. The MOU outlines the responsibilities and important concerns of the fire department. The document should be approved and revised frequently in order to maintain currency. Adoption of this MOU will require discussion and agreement between the two parties. A flexible and cooperative negotiation process should yield a swift and mutually acceptable agreement.

2. Provide a detailed map showing all primary response routes for emergency Fire and EMS equipment which will not be subject to speed humps or other high impact traffic calming devices.

A detailed map illustrating all primary response routes for Fire and EMS equipment should be created with input from traffic planners and the fire department. The map should include major and minor emergency response routes. Major response routes should not be eligible for high impact calming devices. Minor response routes would be eligible for specific types of calming devices. The map should include all primary response streets (not just collector and arterial streets). This documentation may also include neighborhood residential streets that must be kept clear due to access considerations for emergency equipment. This map should be

updated regularly as changes due to new construction and access become evident.

3. Prohibit installation of speed humps and other high impact traffic calming devices on primary response routes.

While the pressure to expand traffic calming projects in the city cannot be ignored, the department must not forget the maintenance of critical emergency response routes discussed in this report. The cumulative effect of multiple streets with traffic calming devices must also be considered. It is imperative that the MOU be followed consistently when considering traffic calming projects on primary response routes. Traffic calming devices which are shown to have lesser impacts may be considered, but caution should be exercised to ensure that apparatus response times are not significantly affected.

4. Develop a prioritization system for traffic calming solutions.

This “priorities approach” to implementation of traffic calming projects will establish a hierarchy of traffic calming devices and strategies which will allow city planners and the fire department to process projects based on a numbered priority system. The current matrix discusses where specific devices are allowed, but does not provide a system to prioritize those options by assigning a number value. This system should be included in the next revision of the Eugene Arterial and Collector Street Plan.

5. Implement a testing process to determine the effects of other types of traffic calming devices on emergency response times.

One of the significant limitations of this research was that it did not quantify impacts from other types of traffic calming devices currently in use. In order to fully understand and evaluate these devices, considerable evaluation needs to be done to quantify the effects on emergency response. Only then can the fire department provide comprehensive and well-

informed recommendations regarding the placement of traffic calming devices in the City of Eugene.

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APPENDIX A
TIME TRIAL RESULTS

Friendly Street Speed Hump Time Trials (Flat Ground): 10/26/00				
Apparatus	Trip Number/ Speed	Time With Speed Humps In Minutes/Second	Time: No Speed Humps In Minutes/Second	Travel Time Delay In Seconds
Engine 23	1 @ 25 mph	1:12	00:57	:15
	2 @ 25 mph	1:04	00:50	:14
	3 @ 25 mph	1:03	00:50	:13
	1 @ 30 mph	1:02	00:46	:16
	2 @ 30 mph	0:59	00:43	:16
	3 @ 30 mph	1:02	00:44	:18
Truck 22	1 @ 25 mph	1:12	00:53	:19
	2 @ 25 mph	1:14	00:53	:21
	3 @ 25 mph	1:07	00:53	:14
	1 @ 30 mph	1:06	00:46	:20
	2 @ 30 mph	1:08	00:46	:22
	3 @ 30 mph	1:06	00:45	:21
Medic 2	1 @ 25 mph	1:00	00:49	:11
	2 @ 25 mph	0:57	00:51	:06
	3 @ 25 mph	0:57	00:51	:06
	1 @ 30 mph	0:53	00:43	:10
	2 @ 30 mph	0:54	00:45	:09
	3 @ 30 mph	0:54	00:45	:09

Trip Number/Speed: Values calculated on 3 trips for each vehicle type at 25 and 30 mph.

Time With Speed Humps: Time value to cross four speed humps while attempting to maintain assigned speed.

Time With No Speed Hump: Time value to travel same distance without speed humps maintaining assigned speed.

Travel Time Delay in Seconds: Time delay to travel course without speed humps minus travel time for same course distance with speed humps.

Friendly Street Speed Hump Time Trial Summary		
Apparatus	Average Time Delay Per Speed Hump @ 25 mph	Average Time Delay Per Speed Hump @ 30 mph
Engine 23	3.5	4.2
Truck 22	4.5	5.3
Medic 2	1.9	2.3
Average for All Apparatus:	3.3	3.9

Average Time Delay per Speed Hump: Calculated on the average travel time delay in seconds divided by 4 speed humps (number of humps on course).

Average for all Apparatus: Average time delay for each apparatus divided by the three apparatus types.

APPENDIX B

VEHICLE AND STREET DATA

TEST VEHICLE INFORMATION			
VEHICLE TYPE	YEAR	GROSS VEHICLE WEIGHT	WHEEL BASE
Engine 23	1990	39,000 lbs	195"
Pierce Telesqurt			
Truck 22	1989	66,600 lbs	252"
Pierce Aerial Platform			
Medic 2	1993	NA	135"
Ford/Braun Ambulance			

TEST STREET INFORMATION			
FRIENDLY STREET COURSE LENGTH:	AVERAGE DISTANCE BETWEEN SPEED HUMPS:	NUMBER OF SPEED HUMPS:	STREET GRADE
1868 Feet	300 Feet	4	Flat

APPENDIX C

MEMORANDUM OF UNDERSTANDING

City of Eugene**Fire & EMS Department/Public Works-Transportation Department****Memorandum of Understanding:****The Use of Traffic Calming Devices****Effective:****1.0 General Policy Description**

The City receives numerous citizen requests each year requesting measures to reduce vehicle speeds and/or local traffic in neighborhoods. To address these issues, the City works with neighborhoods as part of the City's Neighborhood Transportation Program. Although education and less-restrictive measures are the preferred approaches to calming traffic, experience has shown that on some streets, the use of traffic calming devices may be more appropriate. Experience has also shown that the use of traffic calming devices has a negative impact in delaying response time for emergency services, particularly if there are multiple devices that have a cumulative impact on primary fire response routes.

2.0 Purpose

The purpose of this MOU is to provide an understanding between the Fire & EMS Department and the Public Works-Transportation Department, identify streets throughout the City of Eugene which are used as primary emergency response routes, and formalize a process to include the Fire & EMS in the review of neighborhood traffic calming projects. It is recognized that the use of physical devices to control vehicle traffic is desired by many Eugene neighborhoods to protect and preserve the quality of life in those neighborhoods, and that a reasonable approach will be taken in the development and implementation of neighborhood traffic calming plans.

3.0 Policy

- 3.1 All traffic calming projects will be reviewed by the Fire Chief or his/her designee prior to installation. Every effort shall be made to include the Fire & EMS Department in the development and design process from the earliest stages of design concept.
- 3.2 A neighborhood street plan map will be used as a guide to determine the type of device that would be acceptable for a particular street segment. In addition, guidelines regarding vehicle speeds, adjacent land-uses and area topography will be taken into consideration.

- 3.3 The Departments recognize that some traffic calming projects may cause a “cumulative impact” on fire response. Cumulative impact is defined as: **“the potential negative impacts on emergency response time and route patterns by projects on two or more adjacent fire response routes.”** When these situations occur, the Departments will estimate the amount of potential delay based on vehicle delay calculations, and determine if the delay is at an acceptable level. If unacceptable (based on performance measures of the Fire and EMS Department), the traffic plan will be modified with less restrictive physical measures.
- 3.4 A Fire Department representative will attend neighborhood traffic meetings to discuss the effects of traffic calming devices. Should the Fire & EMS Department be unavailable to attend the meeting, a flyer will be distributed on “Emergency Response Delay” by Transportation staff. The flyer will note the implications of traffic calming devices on emergency response times. The flyer will clearly state that “We realize the importance of residents understanding that physical devices like speed humps and traffic circles cause delays for emergency vehicles which may adversely impact the outcome of certain life-threatening incidents. Those in favor of these devices must be willing to accept the likely probability of slower fire and emergency medical service delivery in their community and neighborhoods”.
- 3.5 Before final design, the Fire & EMS Department will be invited to participate with Transportation staff in a “field review” of any proposed traffic calming device location. During this time, the device will be painted on the pavement and cones used to verify turning radius, etc. of fire apparatus. Modifications will be made to the plan as necessary to accommodate these vehicles.
- 3.6 Once the project is constructed, Transportation staff will evaluate the effectiveness of the project and share its findings with the Fire & EMS Department. At that time, modification and/or removal may take place depending on the effectiveness of the installation in meeting the communities needs.

Approved this _____ day of _____, 200_

Thomas Tallon, Fire Chief

_____ Public Works Director